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Oral
(Virtual Talk)
Semi-arid regions contribute substantially to the inter-annual variability of the global carbon sink. Southern hemispheric Africa has large semi-arid and arid regions. However, the sparse coverage of in-situ CO2 measurements on the southern hemisphere leads to uncertainties in measurement-based carbon flux estimates for these regions. Also, dynamic global vegetation models (DGVMs) show a large spread in their carbon flux estimates pointing to an incomplete representation of semi-arid carbon cycle processes in most of the models. Here, we show the potential of satellite data to

1) improve sub-continental scale carbon flux estimates on the southern hemisphere.
2) be used as atmospheric constraints on process-based vegetation models.

We examine GOSAT CO2 concentration measurements from 2009 to 2018 in southern Africa (south of 10°S). Using the atmospheric inversion system TM5-4DVar, we infer CO2 land-atmosphere exchange fluxes which are consistent with the GOSAT measurements. These satellite-based carbon fluxes show systematic differences to atmospheric inversions based on in-situ measurements. Due to the sparseness of in-situ stations, these in-situ based inversions rely heavily on prior flux information for the African region. We use the GOSAT based fluxes and additionally GOME-2 Solar Induced Fluorescence (SIF) to select DGVMs that simulate CO2 fluxes that are compatible with the atmospheric constraints. The DGVM selection allows for deciphering the vegetation processes driving the southern African carbon cycle. We show that the seasonal cycle of southern African carbon fluxes is substantially influenced by enhanced soil respiration following rewetting at the beginning of the rainy season. The inter-annual variability of the African carbon fluxes, however, is mainly driven by varying magnitude of photosynthetic uptake caused by precipitation and temperature anomalies.
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